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EFFECT OF SUPPLEMENTAL IODINE ON PERFORMANCE, HEMATOLOGY AND SELECTED SERUM CONSTITUENTS OF COARSE-WOOL LAMBS

(With 4 Tables and One Figure)

By

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تأثير اضافة اليود علي كفاءة الاداء وعلي صورة الدم
ومختارات من مكونات السيرم في الحملان ذات الصوف الخشن

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استخدم فى هذه الدراسة ٢٧ من الحملان الصعيدي عمر ٨ شهور ومتوسط وزن ٢٠ر٣٧ ± ٧٥ر كجم وقد تم تقسيمها الي ثلاثة مجاميع حسب المعاملات كالآتي : (C) الكنترول وهذه لم تأخـذ يوديد بوتاسيوم علي الاطلاق ، (L) وكانت تأخذ ٤٠ مجم يوديد بوتاسيوم للرأس في يوديـد البوتاسيوم للرأس في ألاسبوع ، (H) وكانت تأخذ ٨٠ مجم يوديد بوتاسيوم للرأس فـــى الاسبوع وقد تم تغذية الحملان فى جميع المعاملات علي عليقة مركزة حتي الشبع · وقد تم اخـذ عينات من دم جميع الحملان بعد ٢٩ ، ٥٧ ، ٨٢ يوما من بداية التجربة فى التاسعة صباحا وفـى الرابعة مساءا من هذه الأيام · وقد وجد أن المعاملات لم تؤثر تأثيرا معنويا علي كل من كمية الغذاء المأكول ، معدل النمو اليومى أو الكفاءة التحويلية للحملان · ومع ذلك فقد لوحظ اتجاه طفيف من الحملان التي تأخذ يوديد بوتاسيوم الي تقليل الغذاء المأكول بدرجة تتناسب مـــع الجرعة المعطاة · وكذلك فقد لوحظ ان معدل النمو اليومي كان يميل الى الزيادة في المعاملـــة (L) (C) بينما حققت المعاملة (H) أقل نمو خلال فترة التجربة · ولم تؤثـــــــر المعاملات علي كل من عدد كرات الدم الحمراء ، كمية الهيموجلوبين ، نسبة الهيماتوكريـــــت وقد سجلت عينات الساعة التاسعة صباحا قيما أعلي في عدد الكرات الحمراء ونسبـــــــــة الهيماتوكريت عما تم تسجيله في عينات الرابعة مساءا · أما عدد كرات الدم البيضاء فقـــد لوحظ انه أقل بدرجة معنوية في حملان المعاملة (H) في اليوم ٢٩ من التجربة عنه في كل من حملان المعاملات (C) (L) وقد لوحظ زيادات غير معنوية في البروتين الكلي والألبيومين في سيرم الدم بينما لوحظ نقص في الكوليسترول في حملان المعاملة (H) بالمقارنة بحملان المعاملات (L) أو (C) · لم يلاحظ أي اختلافات معنوية بين المعاملات فى درجة حـــرارة الجسم أو معدل التنفس أو النبض · وقد أوضحت الدراسة أنه لم يحدث أي آثار سيئة علـــي صورة الدم أو مكونات السيرم نتيجة اعطاء الحملان الجرعات المحددة في هذه التجربـــــة · واتضح أيضا من هذه النتائج مدي الحاجة الي مزيد من الدراسات لمعرفة تأثير اضافة اليود الي غذاء حيوانات المزرعة المختلفة وفي مراحل مختلفة من دورة التناسل علي انتاجية وصحـــــة هذه الحيوانات نظرا لأن المعلومات المنشورة عن هذا الموضوع ما زالت قليلة وغير واضحـــة ·

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SUMMARY

Twenty-seven Saidi lambs (BW, 20.37 $\pm$ 0.75; age 8 mo) were randomly assigned to three treatment groups: a control group (C) receiving no KI supplement, and two supplemented groups (L) and (H) receiving 40 and 80 mg KI/head/wk, respectively. All groups were fed a concentrate pelleted diet ad libitum during the 84-d experimental period. Blood samples were collected from all lambs twice a day (0900 h and 1600 h) at days 29, 57 and 82 of the experiment. Treatment did not affect (P 0.10) feed intake, average daily gain (ADG) or feed efficiency of lambs. However, feed intake tended to decrease with increasing KI level and ADG tended to be higher in L than C lambs, whereas H lambs gained the lowest over the whole experimental period. Treatment did not affect (P 0.10) erythrocyte counts, hemoglobin (Hb) concentration or packed cell volume (PCV). Erythrocyte counts and PCV were higher at 0900 than 1600 h. Total number of leukocytes was lower (P 0.10) only at d 29 of the trial in H lambs than either C or L lambs. Serum total protein, albumin and globulin tended to be higher, whereas cholesterol tended to be lower in H lambs than C or L lambs, but differences were not significant (P 0.10). Body temperture, respiratory and pulse rates did not differ among treatments.

(Key Words: Iodine, Sheep, Hematology, Blood, Growth).

INTRODUCTION

Iodine was one of the first trace elements to be recognized as important to normal body functions. Most of the iodine in the body (70-80%) is found in the thyroid gland. Its chief effects as thyroxine are stimulation of protein, fat and carbohydrte metablism affecting growth and development of the body, and works very closly with growth hormone and insulin (KUTSKY, 1981). It is absorbed very efficiently as iodide or thyroxine. Iodine deficiency exists as an area problem throughout the world. The most common sign of iodine deficiency is enlargement of the thyroid gland, however, stunted growth of farm animals in iodine-deficient areas is not always associated with goiter. In Assiut, some lambs (especially twins) are born weak, dead or without wool. In adult sheep, reduced conception rate and wool yield have been observed which might be due to iodine deficiency. Moreover, none of the common feedstuffs, with the exception of fish meal from salt-water fish, is rich in iodine. Therefore, the objective of this study was to determine whether or not supplemental dietary iodine would affect lamb performance and blood constituents of feedlot lambs.

MATERIAL and METHODS

Twenty-seven Saidi lambs (nine males and 18 females) were adapted to a control diet one wk before starting the trial on September 1990. Average initial body weitht and choleterol were only estimated in samples obtained at the end of the trial (d 82), using commercial assay kits supplied by bioMerieux, France.

Statistical Analysis :

Data were analyzed by analysis of variance (ANOVA) procedures of the Statistical Analysis System (SAS, 1987) for personal computers. A test of equality of variances for males and females was performed for each variable. Whenever no difference was detected, data were combined and statistically analyzed. Pen means for average daily gain (ADG), average daily feed intake and feed efficiency (feed/gain) were analyzed by split-plot ANOVA for repeated measurements (GILL and HAFS, 1971) with effects of TRT, pen within TRT, period (28-d intervals) and TRT x period interaction. Pen within TRT was used as the error term to test TRT effects across time periods. Blood data were analyzed by double split-plot (day and hour) analysis of variance. One lamb of the L group died at d 20 of the experiment and was excluded from the analysis.

RESULTS

Results are presented in Figure 1 and Tables 1,2,3 & 4.

DISCUSSION

I- Lamb Performance :

The visible mucous membranes of lambs assumed normal and appeared as bright red. Also, fecal samples were negative for parsitic infestation.

Body Temperature, Respiration and Pulse Rate: Mean values of body temperature, respiratory and pulse rates for lambs in the present study (Table 1) coincided with those recorded by KELLY (1984). No significant differences (P 0.10) were found among TRT or days of experiment. As shown in Table 1, changes in body temperature were very samll among either TRT or days of the experiment. But, respiratory rate tended to increase consistently with days of experiment. Pulse rate showed some fluctuations during the experimental period and the average of the control group tended to be higher than that of iodine supplemented groups.

Feed Intake: During the first mo of the trial, means of feed intake in all groups were the lowest and did not exceed 0.87 Kg/head/d as fed basis (Table 2) then it increased during the second mo and reached the highest levels during the third mo. Decreased ambient temperature (besides the increase in age and size of lambs) could have contributed to the increase in feed intake of lambs, because the trial strated in September when the weather was still hot in Assiut and ended in December when it was relatively cold. Treatment did not significantly affect feed intake (P 0.10) of lambs (Table 2). But TRT overall means indicate that feed intake tended to decrease with increasing the level of KI administered to lambs (1.16, 1.13 and 1.11 Kg/head/d for C, L and H TRT groups, respectively), although iodine (I) levels used in the present study are still far behind the maximum tolerable level of 50 ppm for sheep and cattle (NRC, 1985). Data on the effect of dietary I on feed intake of sheep and its margins of safety are scarce. In calves, HEMKEN (1981) reported that 50 ppm I in the form of ethylenediamine dihydriodide (EDDI) produced coughing and nasal discharge in some studies; and in some others as little as 50 mg daily of EDDI for six mo caused some symptoms of I toxicity. Lactating dairy cows appear to have a higher tolerance than calves, because a high percentage of the I is secreted in milk.

Body Weight Gain and Feed Efficiency: At the start of the experiment, BW means were similar for the three groups; 20.27, 20.20 and 20.63 ± 1.30 Kg/head for C, L and H groups, respectively. Body weight changes are presented in fig. 1. Treatments did not affect (P 0.10) BW of lambs.

In terms of ADG, all TRT means were low during the first and second mo of the trial (Table 2). The highest means were recorded during the last mo because of the increase in feed intake. Treatment overall means showed that lambs receiving 40 mg KI/head/wk achieved the highest ADG (126 g/head), whereas the control gained faster (113 g/head) than those receiving 80 mg KI/head/wk (98 g/head), however, these differences were not significant (P 0.10). similarly, HEMKEN et al. (1972) found that feeding supplemental I in the form of KI (1.1, 6.8 mg/head daily) for 10 wk did not affect feed intake or growth rate of dairy calves. DOWNER et al. (1981) recorded ADG of 1.4, 1.5 and 1.6 Kg for yearling steers fed 0, 40 and 400 mg EDDI (ethylenediamine dihydriodide). These differences were not significant. On the other hand, BUILOV (1975) found that I supplementation (KI) to Romney Marsh ewes increased litter size, birth weight of lambs and lamb viability to weaning. KNIGHTS et al. (1979) reported that Merino lambs born to iodine-supplemented (KI) ewes were heavier (P 0.01) at birth and at 90 d of age than those born to non-supplemented ewes. Although they stated that there were no reports of the presence of hypothyroid conditions in either humans or livestock in the region where they conducted their experiments (northwest Queensland). Treatment did not affect (P 0.10) feed efficiency (Table 2). Best feed efficiency mean were obtained during the last mo of the experimental period, due to increased feed intake and growth rate.

II- Hematologic Picture :

Total Erythrocyte Count (RBC): Means of RBC numbers/mm^3 (Table 3) are within ovine range (8-16 millions/mm) reported by HACKETT et al. (1957); SCHALM (1961); ULREY et al. (1965) and BLUNT (1975) in foreign breeds of sheep. In Upper Egypt, ABD EL-ALL (1983) obtained relatively lower means (9.16×10^6/mm) but still within ovine range of values.

Treatment did not affect number of RBC significantly. All TRT groups had similar means of RBC (11.49, 10.81 and 11.66 ± 0.42 milion cells/mm for C,L and H, respectively). The interaction between TRT and period (days) was not significant (P .010). As shown in Table 3, TRT groups behaved similarly within sampling days. Al groups had the lowest means at d 29 of the trial, the highest means at d 57 and inermediate means were recorded at d 82.

Bleeding hour had a significant effect on number of RBC. At 0900 h number of RBC averaged 12.20 ± 0.26 million cells/mm, where the average at 1600 h was 10.48 ± 0.26.

Hemoglobin (Hb): Means of Hb concentration (Table 3) fall within the range of values (9-13 g/dl) reported by HACKETT et al. (1957); SCHALM (1961); ULLREY et al. (1965) and BLUNT (1975) in foreign breeds of sheep. In upper Egypt, ABD EL-ALL (1983) also reported similar mean (11.19 g/dl) in healthy sheep at puberty.

An interaction (P 0.06) between Hb concentration and day of sampling was noted. At d 29 of the trial, lambs of the L group tended to have lower (P 0.16) Hb concentration than those of C or H groups (Table 3). At d 82 the control group attained the highest mean, whereas the supplemented groups exhibited similar means.

Bleeding hour had no effect (P 0.10) on Hb concentration (11.27 vs 11.37 g/dl at 0900 and 1600 h, respectively).

Packed Cell Volume (PCV): Means of PCV (Table 3) are in agreement with HACKETT et al. (1957); SCHALM (1961); ULLREY et al. (1965) and BLUNT (1975) in foreign breeds of sheep and with ABD EL-ALL (1983) in native breeds.

Treatment did not affect (P 0.10) PCV (Table 3). The only difference (P 0.01) in PCV was due to bleeding hour, because bleeding hour had a significant effect on total erythrocyte count which was reflected upon the PCV level. At 0900 h, PCV mean was 32.76% and was 31.42% at 1600 h.

White Blood Cells (WBC): Means of WBC at d 57 (Table 3) fall within the range (4-13.6 X 10 /mm) reported by SCHALM (1961) and BLUNT (1975) and ABD EL-ALL (1983), but were higher than that range at d 29 and 82 of the trial.

An interaction (P/0.01) was observed between TRT and day of sampling. When data were analyzed within days, results revealed that group H lambs which received the higher dose of KI had lower (P/0.05) WBC mean at d 29 than either those of L or C groups (Table 3). Differences at d 57 and 82 were not significant (P 0.10). There was also an interaction (P/ 0.10) between TRT and bleeding hour. Treatments did not differ (P 0.10) at 0.900 h. Means were 13.57, 15.09 and 12.59 thousand cells/mm for C, L and H TRT groups, respectively. At 1600 h, significant differences (P 0.05) occurred between C and H TRT groups (13.46 vs 11.33 thousand cells/mm), whereas group L had intermediate mean (12.78). In both bleeding times, H lambs had the lowest means.

III- Selected Serum Constituents :

Means of serum total protein, albumin, globulin and cholesterol concentrations (Table 4) are in agreement with those obtained by HALLFORD and GALYEAN (1982); SHETAEWI and ROSS (1990) and SHETAEWI and ROSS (1991) in fine wool sheep. No significant differences (P/0.10) were detected among treatments. However, serum proteins tended to be higher in H treatment than C or L treatments. This might be attributed to increased thyroid activity in H lambs; because thyroid hormones accelerate

(BW) was 20.37 ± 0.75 Kg and average age was 8 cm. The trial was conducted in Animal production Experiment Station of the Faculty of Agriculture, Assiut University, Egypt.

General signs of health were examined according to ROSENBERGER (1979). Fecal samples were collected from all lambs and examined for parasitic infestation as described in the Mannul of Parasitological Laboratory Techniques (1971).

Lambs were assigned to nine pens (three/pen) and treatments (TRT) were assigned at random to pens with three pens per TRT (one pen for males and two for females in each TRT). Treatments included: a control group (C) receiving no iodine supplementation; a supplemented group (L) receiving 40 mg KI/head/wk (20 mg twice/head/wk) and another supplemented group (H) receiving 80 mg KI/head/wk (40 mg twice/head/wk). These doses were almost similar to those given by KNIGHTS et al. (1979) to Merino ewes in Australia. The Experimental dose of KI (20 or 40 mg) was dissolved in 30 ml of water and drenched individually to lambs of the respective TRT groups. Iodine requirement of sheep is .10 to .80 ppm in diets not containing giotrogens, the higher level being indicated for pregnancy and lactation (NRC, 1985). Therefore, according to an averge requirement of about .5 ppm of iodine (or .5 mg daily), lambs of L and H groups received more than 8.5 and 17 times the iodine requirements, respectively from the KI supplement. All TRT groups were fed ad libitum a pelleted commercial concentrate diet consisting of wheat bran, corn, cottonseed meal, soybean meal, molasses, flax straw, rice hulls, limestone and salt. The concentrate diet (as fed basis) contained 10.04% moisture, 13.96% crude protein, 6.17% either extract, 14.12% crude fiber, 49.47% nitrogen free extract and 6.24% ash. Feed refusals were recorded daily over a 84-d feeding period. Feed intake per pen was calculated. Body weights were obtained (after an overnight fast) every fortnight throughout the experiment. Body temperature, respiratory and pulse rates were measured for all lambs on d 31, 58 and 84 of the trial.

Blood Sampling and Procedures :

Blood samples were obtained from all lambs at d 29, 57 and 82 of the experiment. During each of these days samples were collected at 0900 and 1600 h. Animals were kept off feed and offered only water between the two sampling hours. Blood samples were collected by jugular venipuncture using a clean dry plastic syringe and then (after removing the needle) transferred to: 1) dry clean glass vials containing the dipotassium salt of ethylenediaminetetraacetic acid (EDTA) at a final concentration of 1 mg/ml of blood, 2) dry clean 10-ml centrifuge tubes, where blood was allowed to clot. Serum was then separated by centrifugation at 3000 rpm for 15 min., decanted into clean dry glass vials and stored at 20°C until analyzed. Noncoagulated blood was used for estimation of total number of red blood cells (RBC), white blood cells (WBC), hemoglobin (Hb) using electronic cell counter and its diluter (Cell Dyne 300 Sequoia Turnor). Packed cell volume (PCV) was estimated according to the standard methods of hematology (SCHALM, 1961; COLES, 1986). Serum total protein, albumin, globulin cellular reactions in most organs and tissues of the body, including the liver in which these proteins are formed (SMITH et al., 1983). On the other hand, serum cholesterol was lower by about 15% in H lambs compared to C lambs which might be attributed to increased thyroid activity in H lambs, too. Serum cholesterol was previously used as an index of thyroid function because hypothyroidism is generally associated with an elevation of serum cholesterol (KANEKO, 1980; DUNCAN and PRASSE, 1986).

In conclusion, feed intake of lambs tended to decrease with increasing KI level and ADG tended to be higher in lambs that received the lower level of KI than control lambs, whereas those receiving the higher level gained the lowest over the whole experimental period. The study also declared no adverse effects of supplemental iodine, by the dosage levels evaluated in this study, upon the hematologic picture or serum constituents. More studies are needed to learn more about the effects of iodine supplementation to different classes of livestock and at different stages of the reproductive cycle on productivity and health of animals because published data are scarce and unclear.

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Figure 1. Effect of Iodine Supplementation on Body Weight of Lambs.

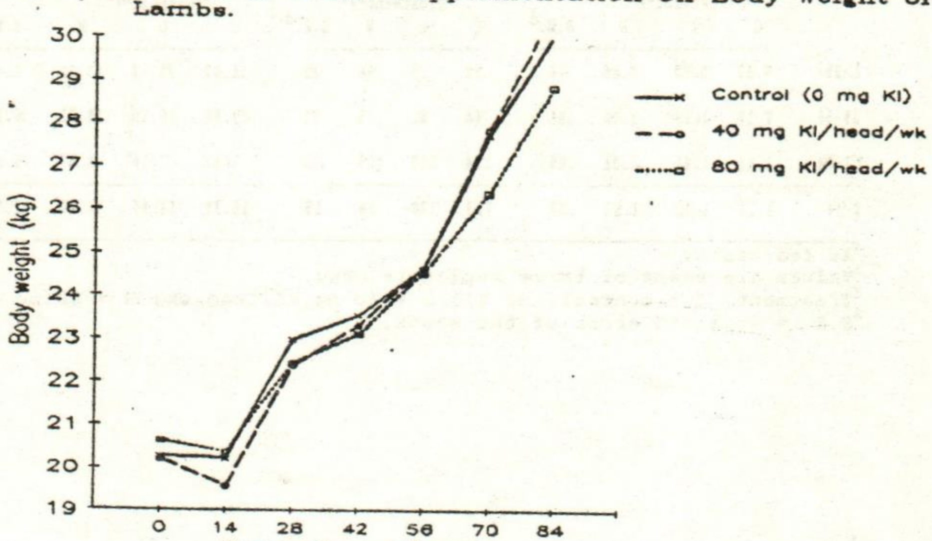

Table 1. Body Temperature, Respiratory and Pulse Rates of Lambs Receiving 0, 40 or 80 mg KI/head/wk.

Day of Experiment	Body Temp. (°C)			Respiratory rate (breaths/min.)			Pulse rate (beats/min.)		
	Treatment[a,b,c]			Treatment[a,b,c]			Treatment[a,b,c]		
	C	L	H	C	L	H	C	L	H
31	39.7	39.6	39.5	25.8	25.8	24.7	71.3	66.5	72.7
58	39.6	39.6	39.5	31.3	28.3	30.9	91.3	80.0	77.3
84	39.3	39.1	39.1	33.3	36.0	33.8	78.2	86.0	72.0
Overall	39.5	39.4	39.4	30.1	30.0	29.8	80.3	77.5	74.0
S.E.[d]	.07	.07	.07	1.0	1.1	1.0	2.7	2.8	2.7

[a]Values are means of 9 lambs in groups C, H and 8 lambs in group B.
[b]Treatment, C = control, no KI; L= 40 mg KI/head/wk; H = 80 mg/head/wk.
[c]Largest standard error of treatment means within days = .10 for body temp. 1.9 for respiratory rate and 5.7 for pulse rate.
[d]Standard error of treatment means.

Table 2. Feed Intake, Average Daily Gain and Feed Efficiency of Lambs Receiving 0, 40 or 80 mg KI/head/wk.

Day of Experiment	Feed intake (kg/head/day)[a]				Average daily gain g/head/day				Feed efficiency, (Feed/Gain)[a]			
	Treatment[b,c]				Treatment[b,c]				Treatment[b,c]			
	C	L	H	S.E.[d]	C	L	H	S.E.[d]	C	L	H	S.E.[d]
0-28	0.87	0.80	0.85	.06	98	79	66	25	11.87	21.67	13.72	6.47
29-56	1.18	1.19	1.16	.06	48	81	75	25	29.85	16.10	19.71	6.47
57-84	1.43	1.41	1.31	.06	194	218	155	25	7.47	7.10	8.57	6.47
0-84	1.16	1.13	1.11	.07	113	126	98	19	16.39	14.95	14.00	2.99

[a]As fed basis.
[b]Values are means of three replicate pens.
[c]Treatment, C = control, no KI; L = 40 mg KI/head/wk; H = 80 mg KI/head/wk.
[d]S.E. = standard error of the means.

Table 3. Number of Red Blood Cells, Hemoglobin, Packed Cell Volume and White Blood Cells (WBC) in Lambs Receiving 0, 40 or 80 mg KI/head/wk.

Day of Experiment	Red blood cells RBC ($10^6/mm^3$)			Hemoglobin[d] Hb (g/dl)			Packed cell volume PCV (%)			White blood cells[d] WBC ($10^3/mm^3$)		
	Treatment[a,b,c]			Treatment[a,b,c]			Treatment[a,b,c]			Treatment[a,b,c]		
	C	L	H	C	L	H	C	L	H	C	L	H
29	8.03	7.89	8.85	10.62	9.47	11.25	29.33	29.38	27.61	17.91	17.42	12.44
57	14.79	12.91	14.19	10.87	10.93	10.91	33.17	32.13	33.82	8.47	9.13	8.95
82	11.66	11.62	11.95	13.36	12.24	12.1	35.39	34.69	33.39	14.16	15.25	14.67
Overall	11.49	10.81	11.66				32.63	32.06	31.57			
S.E[e]	0.4	0.42	0.40				1.3	1.38	1.3			

[a]Values are means of 18 samples (9 lambs sampled twice/day) in group C, H and 16 samples in group L (8 lambs)
[b]Treatment, C= control, no KI; L= 40 mg KI/head/wk; H= 80 mg KI/head/wk.
[c]Largest standard error of the mean within days = .88 for RBC, .44 for HB, 1.38 for PCV and 1.02 for WBC.
[d]An interaction was noted between Hb concentration and day of experiment (P<.06) and between number of WBC and day of experiment (P<.01).
[e]Standard error of treatment means.

Table 4. Serum Total Protein, Albumin, Globulin and Cholesterol in Lambs receiving 0, 40 or 80 mg KI/head/wk.

Constituent	Treatment[a,b,c] C	L	H	S.E.[d]
Total Protein, g/dl	6.38	6.38	6.76	.31
Albumin, g/dl	3.45	3.48	3.70	.10
Globulin, g/dl	2.93	2.90	3.06	.27
Cholesterol, mg/dl	70.91	67.58	60.98	5.10

[a]Values are means of 18, 16 and 16 samples for C, L and H treatments, respectively.
[b]Treatment; C = control, no KI; L = 40 mg KI/head/wk; H = 80 mg/head/wk.
[c]No significant differences (P>.10) were detected among treatment means.
[d]Largest standard error of treatment means.